WHAT IS CLAIMED:

1. A method of detecting presence of an otolaryngologic pathogen in a biological sample:

providing a sensor device comprising (i) a substrate having two or more nucleic acid probes respectively confined to two or more distinct locations thereon, and (ii) a detector that detects the binding of target nucleic acids of a biological sample to the two or more nucleic acid probes, wherein a target nucleic acid is specific to one or more otolaryngologic pathogens;

exposing the biological sample, or a portion thereof, to the sensor device under conditions effective to allow hybridization between the two or more nucleic acid probes and a target nucleic acid to occur; and

detecting with the detector whether any target nucleic acid hybridizes to the two or more nucleic acid probes, wherein hybridization indicates presence of the otolaryngologic pathogen in the biological sample and presence of more than one otolaryngologic pathogen can be detected simultaneously.

2. The method according to claim 1 wherein the otolaryngologic pathogen is selected from the group of *Campylobacter jejuni*, *Campylobacter*, *Helicobater pylori*, *Listeria monocytogenes*, *Listeria*, *Staphylococcus aureus*, *Chlamydia pneumoniae*, *Haemophilus influenzae*, *Streptococcus pneumoniae*, α and β hemolytic Streptococcus, *Streptococcus*, *Moraxella catarrhalis*, *Pseudomonas aeruginosa*, *Salmonella*, parainfluenzae viruses, influenzae viruses, rhinoviruses, otolaryngologic fungi, otolaryngologic parasites, otolaryngologic parasites, and otolaryngologic prokaryotes.

3. The method according to claim 1 wherein the target nucleic acid is a DNA molecule.

4. The method according to claim 1 wherein the target nucleic acid is an RNA molecule.

5. The method according to claim 1 wherein the target nucleic acid is an rRNA molecule.

6. The method according to claim 1 wherein the two or more nucleic acid probes are coupled to the substrate.

7. The method according to claim 6 wherein the substrate comprises a silicon oxide wafer carrying a thermal oxide coating.

8. The method according to claim 6 wherein the sensor device further comprises one or more nanocrystal particles comprising a semiconductor material, the one or more nanocrystal particles being coupled to the substrate via the two or more nucleic acid probes.

9. The method according to claim 8 wherein the sensor device further comprises one or more quenching agents each coupled to a non-target nucleic acid, the non-target nucleic acid being reversibly coupled to a nucleic acid probe with an affinity that is lower than the affinity between the nucleic acid probe and the target nucleic acid.

10. The method according to claim 8 wherein said detecting comprises:
illuminating the sample and sensor device; and
measuring fluorescence by the one or more nanocrystal particles, whereby fluorescence indicates displacement of the non-target nucleic acid and quenching agent from the nucleic acid probe.

11. The method according to claim 6 wherein the substrate comprises a porous semiconductor structure comprising a central layer interposed between upper and lower layers, each of the upper and lower layers including strata of alternating porosity.

12. The method according to claim 11 wherein said detecting comprises measuring the refractive index of the substrate, whereby a change in the refractive index indicates the binding of a target nucleic acid to a probe.

13. The method according to claim 6 wherein the substrate includes a translucent coating having front and back surfaces and the detector comprises a light source positioned to illuminate the substrate whereby, in the absence of a target nucleic acid, near perfect interference occurs between light reflected by the front and back surfaces.

14. The method according to claim 13 wherein said detecting comprises measuring the light reflected by the front and back surfaces of the coating, whereby loss of interference indicates binding of a target nucleic acid to a probe.

15. The method according to claim 13 wherein the substrate comprises undoped silicon and the coating comprises silicon dioxide.

16. The method according to claim 6 wherein the substrate comprises a fluorescence quenching surface and each of the two or more probes comprises first and second ends with the first end bound to the fluorescence quenching surface and the second end bound to a fluorophore, a first region, and a second region complementary to the first region, the probe having, under appropriate conditions, either a hairpin conformation with the first and second regions hybridized together or a non-hairpin conformation, whereby when the probe is in the hairpin conformation, the fluorescence quenching surface substantially quenches fluorescent emissions by the fluorophore, and when the probe is in the non-hairpin conformation fluorescent emissions by the fluorophore are substantially free of quenching by the fluorescence quenching surface.

17. The method according to claim 16 wherein said detecting comprises:

illuminating the sample and sensor device; and

measuring fluorescence by the fluorophore, whereby fluorescence indicates that at least one of the two or more probes is in the non-hairpin conformation.

18. The method according to claim 1 wherein the two or more nucleic acid probes are each retained within a separate microfluid vessel or channel.

19. The method according to claim 18 wherein the substrate is in the form of a microfluid chip comprising a plurality of microfluid vessels and channels.

20. The method according to claim 19 wherein said detecting comprises

exposing a plurality of metal nanoparticles to the biological sample and the two or more nucleic acid probes, and

determining whether a color change occurs after said exposing the plurality of metal nanoparticles, whereby a color change indicates substantial aggregation of the plurality of metal nanoparticles in the presence of the target nucleic acid.

21. The method according to claim 1 wherein the two or more probes comprise the nucleotide sequence selected from the group of SEQ ID NO: 1, SEQ ID NO: 2, SEQ ID NO: 3, SEQ ID NO: 4, SEQ ID NO: 5, SEQ ID NO: 6, SEQ ID NO: 7, SEQ ID NO: 8, SEQ ID NO: 9, SEQ ID NO: 10, SEQ ID NO: 11, SEQ ID NO: 12, SEQ ID NO: 13, SEQ ID NO: 14, SEQ ID NO: 15, SEQ ID NO: 16, SEQ ID NO: 17, SEQ ID NO: 18, SEQ ID NO: 19, SEQ ID NO: 20, SEQ ID NO: 21, SEQ ID NO: 22, and complements thereof; and combinations thereof.

22. The method according to claim 1 wherein the two or more probes are specific to different otolaryngologic pathogens.

23. The method according to claim 1 wherein at least two of the two or more probes are specific to the same otolaryngologic pathogen and at least one additional probe is specific to a different otolaryngologic pathogen.

24. A sensor device comprising:

a substrate having two or more nucleic acid probes respectively confined to two or more distinct locations thereon and

a detector that detects the hybridization of target nucleic acids to the two or more nucleic acid probes upon exposure to a biological sample, wherein a target nucleic acid is specific to one or more otolaryngologic pathogens and hybridization indicates presence of the otolaryngologic pathogen in the biological sample, the detector

being capable of simultaneously detecting presence of more than one otolaryngologic pathogen in the biological sample.

25. The sensor device according to claim 24 wherein the otolaryngologic pathogen is selected from the group of *Campylobacter jejuni*, *Campylobacter*, *Helicobater pylori*, *Listeria monocytogenes*, *Listeria*, *Staphylococcus aureus*, *Chlamydia pneumoniae*, *Haemophilus influenzae*, *Streptococcus pneumoniae*, α and β hemolytic Streptococcus, *Streptococcus*, *Moraxella catarrhalis*, *Pseudomonas aeruginosa*, *Salmonella*, parainfluenzae viruses, influenzae viruses, rhinoviruses, otolaryngologic fungi, otolaryngologic parasites, otolaryngologic parasites, and otolaryngologic prokaryotes.

26. The sensor device according to claim 24 wherein the two or more nucleic acid probes are coupled to the substrate.

27. The sensor device according to claim 26 wherein the substrate comprises a silicon oxide wafer carrying a thermal oxide coating.

28. The sensor device according to claim 26 wherein the sensor device further comprises one or more nanocrystal particles comprising a semiconductor material, the one or more nanocrystal particles being attached to the substrate via the two or more nucleic acid probes.

29. The sensor device according to claim 26 wherein the sensor device further comprises one or more quenching agents each coupled to a non-target nucleic acid, the non-target nucleic acid being reversibly coupled to a nucleic acid probe with an affinity that is lower than the affinity between the nucleic acid probe and the target nucleic acid.

30. The sensor device according to claim 26 wherein the substrate comprises a porous semiconductor structure comprising a central layer interposed between upper and lower layers, each of the upper and lower layers including strata of alternating porosity.

31. The sensor device according to claim 26 wherein the substrate includes a translucent coating having front and back surfaces and the detector comprises a light source positioned to illuminate the substrate whereby, in the absence of target nucleic acid, near perfect interference occurs between light reflected by the front and back surfaces.

32. The sensor device according to claim 31 wherein the substrate comprises undoped silicon and the coating comprises silicon dioxide.

33. The sensor device according to claim 26 wherein the substrate comprises a fluorescence quenching surface and each of the two or more probes comprises first and second ends with the first end bound to the fluorescence quenching surface and the second end bound to a fluorophore, a first region, and a second region complementary to the first region, the probe having, under appropriate conditions, either a hairpin conformation with the first and second regions hybridized together or a non-hairpin conformation, whereby when the probe is in the hairpin conformation, the fluorescence quenching surface substantially quenches fluorescent emissions by the fluorophore, and when the probe is in the non-hairpin conformation fluorescent emissions by the fluorophore are substantially free of quenching by the fluorescence quenching surface.

34. The method according to claim 24 wherein the two or more nucleic acid probes are each retained within a separate microfluid vessel or channel.

35. The method according to claim 18 wherein the substrate is in the form of a microfluid chip comprising a plurality of microfluid vessels or channels.

36. The sensor device according to claim 24 wherein the two or more nucleic acid probes comprise the nucleotide sequence selected from the group of SEQ ID NO: 1, SEQ ID NO: 2, SEQ ID NO: 3, SEQ ID NO: 4, SEQ ID NO: 5, SEQ ID NO: 6, SEQ ID NO: 7, SEQ ID NO: 8, SEQ ID NO: 9, SEQ ID NO: 10, SEQ ID NO: 11, SEQ ID NO: 12, SEQ ID NO: 13, SEQ ID NO: 14, SEQ ID NO: 15, SEQ ID NO: 16, SEQ ID

NO: 17, SEQ ID NO: 18, SEQ ID NO: 19, SEQ ID NO: 20, SEQ ID NO: 21, SEQ ID NO: 22, and complements thereof; and combinations thereof.

37. The sensor device according to claim 24 wherein the two or more probes are specific to different otolaryngologic pathogens.

38. The sensor device according to claim 24 wherein at least two of the two or more probes are specific to the same otolaryngologic pathogen and at least one additional probe of the two or more probes is specific to a different otolaryngologic pathogen.

39. A sensor chip comprising a substrate having two or more nucleic acid probes respectively confined to two or more distinct locations thereon, the nucleic acid probes hybridizing to a target nucleic acid of an otolaryngologic pathogen under suitable hybridization conditions, wherein the two or more probes are selected to hybridize, collectively, to target nucleic acids of two or more otolaryngologic pathogens.

40. The sensor chip according to claim 39 wherein the otolaryngologic pathogen is selected from the group of *Campylobacter jejuni*, *Campylobacter*, *Helicobater pylori*, *Listeria monocytogenes*, *Listeria*, *Staphylococcus aureus*, *Chlamydia pneumoniae*, *Haemophilus influenzae*, *Streptococcus pneumoniae*, α and β hemolytic Streptococcus, *Streptococcus*, *Moraxella catarrhalis*, *Pseudomonas aeruginosa*, *Salmonella*, parainfluenzae viruses, influenzae viruses, rhinoviruses, otolaryngologic fungi, otolaryngologic parasites, otolaryngologic parasites, and otolaryngologic prokaryotes.

41. The sensor chip according to claim 39 wherein the two or more nucleic acid probes are coupled to the substrate.

42. The sensor chip according to claim 41 wherein the substrate comprises a silicon oxide wafer carrying a thermal oxide coating.

43. The sensor chip according to claim 41 wherein the sensor chip further comprises one or more nanocrystal particles comprising a semiconductor material, the one or more nanocrystal particles being attached to the substrate via the two or more nucleic acid probes.

44. The sensor chip according to claim 41 wherein the sensor chip further comprises one or more quenching agents each coupled to a non-target nucleic acid, the non-target nucleic acid being reversibly coupled to a nucleic acid probe with an affinity that is lower than the affinity between the nucleic acid probe and the target nucleic acid.

45. The sensor chip according to claim 41 wherein the substrate comprises a porous semiconductor structure comprising a central layer interposed between upper and lower layers, each of the upper and lower layers including strata of alternating porosity.

46. The sensor chip according to claim 41 wherein the substrate includes a translucent coating having front and back surfaces and the detector comprises a light source positioned to illuminate the substrate whereby, in the absence of target nucleic acid, near perfect interference occurs between light reflected by the front and back surfaces.

47. The sensor chip according to claim 46 wherein the substrate comprises undoped silicon and the coating comprises silicon dioxide.

48. The sensor chip according to claim 41 wherein the substrate comprises a fluorescence quenching surface and each of the two or more probes comprises first and second ends with the first end bound to the fluorescence quenching surface and the second end bound to a fluorophore, a first region, and a second region complementary to the first region, the probe having, under appropriate conditions, either a hairpin conformation with the first and second regions hybridized together or a non-hairpin conformation, whereby when the probe is in the hairpin conformation, the fluorescence quenching surface substantially quenches fluorescent emissions by the

fluorophore, and when the probe is in the non-hairpin conformation fluorescent emissions by the fluorophore are substantially free of quenching by the fluorescence quenching surface.

49. The method according to claim 39 wherein said the two or more nucleic acid probes are each retained within a separate microfluid vessel or channel.

50. The method according to claim 48 wherein the substrate is in the form of a microfluid chip comprising a plurality of microfluid vessels and channels.

51. The sensor chip according to claim 39 wherein the one or more probes comprise a nucleotide sequence selected from the group of SEQ ID NO: 1, SEQ ID NO: 2, SEQ ID NO: 3, SEQ ID NO: 4, SEQ ID NO: 5, SEQ ID NO: 6, SEQ ID NO: 7, SEQ ID NO: 8, SEQ ID NO: 9, SEQ ID NO: 10, SEQ ID NO: 11, SEQ ID NO: 12, SEQ ID NO: 13, SEQ ID NO: 14, SEQ ID NO: 15, SEQ ID NO: 16, SEQ ID NO: 17, SEQ ID NO: 18, SEQ ID NO: 19, SEQ ID NO: 20, SEQ ID NO: 21, SEQ ID NO: 22, and complements thereof; and combinations thereof.

52. The sensor chip according to claim 39 wherein the two or more probes are specific to different otolaryngologic pathogens.

53. The sensor chip according to claim 39 wherein at least two of the two or more probes are specific to the same otolaryngologic pathogen and at least one additional probe of the two or more probes is specific to a different otolaryngologic pathogen.

54. A nucleic acid probe comprising a nucleic acid sequence selected from the group of :

SEQ ID NO: 1, SEQ ID NO: 2, SEQ ID NO: 3, SEQ ID NO: 4, SEQ ID NO: 5, SEQ ID NO: 6, SEQ ID NO: 7, SEQ ID NO: 8, SEQ ID NO: 9, SEQ ID NO: 10, SEQ ID NO: 11, SEQ ID NO: 12, SEQ ID NO: 13, SEQ ID NO: 14, SEQ ID NO: 15, SEQ ID NO: 16, SEQ ID NO: 17, SEQ ID NO: 18, SEQ ID NO: 19, SEQ ID

NO: 20, SEQ ID NO: 21, SEQ ID NO: 22, and complements thereof; and combinations thereof.

55. The nucleic acid probe of claim 53 further comprising a fluorophore conjugated to the nucleic acid probe.

56. The nucleic acid probe of claim 53 wherein the nucleic acid probe is capable of self-hybridizing to form a hairpin structure.